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USC/Information Sciences Institute

March 1994

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This report describes a vision of the electronic marketplace, the requirements it must satisfy, an architecture for addressing those requirements, and a graceful migration path to the marketplace from current EDI technology and practice. It identifies five key concepts for government electronic commmerce, and concludes by recommending that the government act to shape the electronic marketplace for the benefit of all by (1) including Internet gateways to VANs; and (2) encouraging pilot projects in procurement over the Internet.

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Electronic Commerce on the Internet

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Introduction

We are on the verge of a new era in electronic commerce, where companies transact business spontaneously over the Internet. In restructuring its procurement processes, The Federal Government has a unique opportunity to exploit this electronic marketplace, and to influence its development in ways that benefit all.

This note describes a vision of the electronic marketplace, the requirements it must satisfy, an architecture for addressing those requirements, and a graceful migration path to the marketplace from current EDI technology and practice. It identifies five key concepts for government electronic commerce, and concludes by recommending that the government act to shape the electronic marketplace for the benefit of all by (1) including Internet gateways to VANs; and (2) encouraging pilot projects in procurement over the Internet.

Vision

In the emerging global electronic marketplace, buyers and sellers from companies large and small meet on equal terms, aided by a wide array of information services that allow them to target or broadcast their communications appropriately. Every aspect of the acquisition process is handled seamlessly; participants need never revert to off-line paper communications. Buyers can browse multimedia catalogs, solicit bids and place orders. Sellers can respond to bids, schedule production, and coordinate deliveries. Third parties lubricate the marketplace via such value-added services as specialized directories, brokering, referral, and vendor certification.

Many of these transactions already occur electronically, but require prior arrangements and dedicated lines or VANs. The resulting costs and lead times create entry barriers to widespread small business participation, hindering expansion of EDI beyond large companies and their major trading partners. What is new are: (1) interactive EDI services in addition to traditional computer-to-computer exchanges; and, (2) an open marketplace where transactions take place spontaneously on public networks, in addition to proprietary ones.

The electronic marketplace is already forming. By the end of 1994, more than ten thousand companies will be offering information and services for sale over a combination of Internet and VAN service providers. Their ranks are expected to swell to 100,000 in three years and a million in five years, when Internet connectivity approaches the ubiquity of fax. By participating actively in this marketplace, and promoting a sensible mix of computer-to-computer and interactive EDI services, the Government will not just promote E-commerce -- it will stimulate the creation of a massive, competitive vendor base.

Requirements

Connectivity is fading as the central issue in Electronic Commerce; it is virtually certain to be provided by the Internet. The net already connects some ten million users in over 130 countries. At current growth rates it will link twenty-five million users by 1995. Millions more send email through the Internet via gateways provided by Compuserve, AT&T, MCI and other leading proprietary networks. The Internet provides connectivity between far more points than any alternative, and does so at very low cost. Anything less is at a competitive disadvantage.

The Internet has a number of limitations and misconceptions that must be overcome before it can be deemed suitable for commerce. Some commonly expressed concerns include reliability, security, scalability, ease of use, and payment. Fortunately, solutions are in hand for these concerns, as discussed below.

An ideal electronic marketplace is open, affordable, and easy to join. Any provider should be able to participate merely by listing its products and services in an appropriate directory or with a suitable broker. The marketplace should also be flexible. What is needed is a rich set of modular services that provide various kinds of procurement assistance, and an open, scalable architecture that links buyers, sellers and service providers through the Internet as well as proprietary networks.

To illustrate, different processes generally apply when purchasing routine parts vs. critical or hard-to-find components. These processes are likely to involve alternative users and providers of value-added procurement services. Say that sourcing information was available as a network service. Such information might be accessed directly by buyers with an urgent need to locate suppliers for a critical item. However, for more routine procurements, the cost and effort of using the sourcing service could be bypassed by publicly broadcasting Requests For Quotes through bidding services provided by Value-Added Networks and through Internet bulletin boards. Such best-of-both-worlds flexibility is only possible if a web of interoperable services is supported.

Finally, the electronic marketplace must provide transparent bridges from existing procurement systems to the web of electronic information service providers. The architecture must, when desired, deliver all the flexibility that the web provides. It must also let organizations structure their interaction with the marketplace, in accordance with business policies and procedures.

Architecture

To satisfy the above requirements, the Electronic Marketplace will be structured as a fully distributed network of product and service providers. Most providers will run their own network servers and maintain full local control over their data, ensuring that the market can scale to accommodate any number of potential participants.

The architectural framework for the Electronic Marketplace has three logical layers: *access mechanisms*, *resources*, and *middleware*. These layers lie on top of the networking connectivity provided by the Internet and its gateways to private networks. Thus, their physical implementation can be widely distributed over the network.

Access mechanisms is the layer at which participants (e.g., government procurement agents, vendors) enter the marketplace from their home environments. Both computer-to-computer and interactive access must be supported. We propose sending EDI X12 or EDIFACT transactions via email for most computer-to-computer transactions. Popular X12 translators and forms packages used by commercial VANs can be readily adapted to handle interactive transactions and email transport. These specialized applications will need to be augmented by direct email communications and by generic interactive navigation tools such as Mosaic. Mosaic is a hypermedia browser developed by the National Center for Supercomputer Applications (NCSA). It provides an intuitive and uniform way of accessing Internet resources without having to master idiosyncratic Internet addresses and log-in procedures. Users simply point and click or fill out an electronic form, and are rewarded with rich multimedia presentations, ideal for commerce.

Mosaic's primary virtue is its huge installed base (over 1 million copies distributed to date). It is designed to work with a distributed network of hypermedia document servers known collectively as the World-Wide Web (WWW). More than 3000 WWW servers are already in operation; nearly half are run by commercial concerns, enabling their customers to view catalogs and product information, try out software, place orders, and take company tours. In the case of information-based products, such as software and CAD models, customers can actually take delivery as well. Ultimately, the standard information formats supported by WWW will encourage many competitors to Mosaic, some of which may be more specialized to the needs of E-commerce. Near-term, Mosaic is the quickest access path to the benefits of WWW.

The Resources layer is where the procurement services reside. These services cover all phases of acquisition from catalogs and bid advertisements through shipping and payment. There are basic services for bid solicitation (e.g., bulletin boards, selective notification) similar to those currently offered by VANs. On the Internet, such services are unbundled from connectivity, and available to all comers. However, e-commerce extends far beyond the scope of current EDI transactions. There will be online catalogs and shopping services, network notaries and public repositories, billing and accounting services, brokering and referral services, as well as vendor certification and credit reporting services, banking services and transportation services. Virtually the entire business infrastructure that has evolved to support paper-based transactions will be replicated to support electronic transactions.

Beyond replication of existing ways of doing business, enterprising entrepreneurs are certain to offer sophisticated e-commerce services that are infeasible in a paper-based economy. One can only imagine what services an electronic market may inspire. Two plausible candidates: using broadcasting or "narrowcasting" to obtain competitive quotes and locate hard to find parts; and coordinating production schedules and transportation across entire supply chains to minimize inventories and excess capacity.

Middleware refers to modular network services that transform the Internet into an "industrial strength" information infrastructure. Here one finds essential functions such as directories, user authentication, access control, accounting algorithms, and electronic payment mechanisms.

Authentication can be accomplished using either Kerberos or Public Key cryptography. The latter is preferrable because it supports direct bilateral transactions, which are essential for spontaneity and scalability. Knowing the identity of ones' trading partner, procedures for access control, billing and accounting are easily implemented.

Building encryption into electronic mail, Mosaic clients and World-Wide Web servers, is the foundation for implementing many other procurement-related services, e.g., non-repudiable digital signatures and time stamps. It also enables the secure transmission of sensitive information such as credit card numbers and bid amounts. Lastly, it provides the means for assuring that messages arrive uncorrupted and untampered. In short, privacy-enhaced mail and Mosaic neutralize reliability and security as issues in using the Internet. In particular, they eliminate the two major culprits in recent computer break-ins: remote logins and exchanging passwords in the clear. At the same time, they facilitate doing business on the Internet by making it possible to sign legally enforceable contracts, maintain audit trails and get paid.

Standards are a central issue in the design of any architecture. For electronic commerce, it is imperative that the framework accommodate multiple, industry-specific EDI transaction sets, and

handle participants with incomplete implementations of any particular set. The architectural framework should allow for translation services that convert between EDI formats, as well as between EDI and non-EDI formats. This gives maximum outreach to the widest supplier base, and frees the marketplace from dependence on the pace of convergence to particular formats.

Getting There

Significant parts of this vision are achievable today. Others involve research and development, and are somewhat further off. The proposed architecture allows us to start building something useful today and grow it into the environment of the future.

Existing Internet hub/gateways, such as ISI's FAST and LLNL's GATEC, provide potential starting points. Using Internet email, buyers can solicit bids and place orders with thousands of EDI vendors who subscribe to traditional VANs. The gateways perform a variety of useful services, such as translation between SMTP and X.400 mail, conversion between multiple X12 formats, conversion between EDI and non-EDI formats, time stamping, and vendor certification. However, they require that all traffic pass through them, posing a potential bottleneck, and inhibiting the creation of new value-added services.

The first step toward a scalable infrastructure is to open these hubs by unbundling their services. Buyers and sellers will be able to exchange Internet email directly or through an email gateway. Other value-added services, such as timestamping a bid or certifying a vendor, can be utilized (and paid for) as needed. Smart Valley's CommerceNet infrastructure is being constructed in this manner.

The next step is to combine current email forms packages and X12 formatters with World-Wide Web facilities like Mosaic. Vendors will use these facilities to put their catalogs and product literature on the Internet, while buyers will use them to post RFQs and bid packages. As use of the Internet and WWW for procurement mushrooms, the role of VANs will inevitably change. Progressive VANs will open up and provide subscribers with full Internet access. The most progressive will offer their proprietary bidding services to anyone on the Internet willing to pay.

Well-structured communications between known points, such as order placement with a selected vendor, will increasingly be handled by computer-to-computer transactions. Email will be used to transmit X12 or EDIFACT transactions for processing in and out of databases by senders and receivers. Broadcasting of messages intended for simultaneous release to a community (e.g., open RFQs) can be accomplished through creation of publicly-accessible files on World-Wide Web servers, email distribution lists, or newsgroups.

As momentum gathers, third parties will begin creating the innovative value-added services discussed above. Initial offerings are likely to be utilitarian: sourcing support, including yellow pages of available vendors (and VAN gateways), part taxonomies, and vendor line card databases; partner information registries, covering issues such as versions of X12 supported, transaction set handled, and formatting conventions; technical information services providing data about parts and processes, and so forth.

Some tasks, such as sourcing, will still involve a significant amount of interactive, human-in-the-loop processing. However, as ARPA's FAST Project has shown, the boundaries between human and automated tasks can be shifted in a number of ways (e.g., automating previously manual look-ups to online information services). Thus, it is important to develop conventions for the internal representation of interactively-presented information to pave the way for future automation. The vendor community should be encouraged to post and maintain their linecards -- and, in the future, parts catalogues -- in a uniform (although yet to be defined) format on the information servers that will constitute the new infrastructure. By encouraging the vendor community to do so, the maintenance burden is distributed; individual businesses are responsible for their own entries. The SBA's PASS database is an excellent starting point for this endeavor.

More sophisticated services will build on these initial ones. For instance, brokering services will use the sourcing data to match buyers and sellers. Translation services will use the partner information profiles to convert between electronic data interchange formats -- and even between EDI and non-EDI media such as faxes. Part locating services will use the technical data to create substitution lists. Unleashing this proliferation of services is fundamentally what open electronic markets are all about.

Key Concepts for Government Electronic Commerce

To be ready to meet the future, the government's electronic commerce framework should embody the following concepts:

1. **Distributed implementation.** The architectural framework should modularize procurement functions and allow their implementation to be physically distributed over the network. This approach does not preclude management control, which lies in the protocols by which components communicate. It promises lower implementation and maintenance costs by leveraging commercial participation.

2. **Networks within networks, using email for transport.** The architecture should allow any participant to communicate to others as needed, with communications flowing within a VAN, across VANs bridged by the Internet, or entirely within the Internet. This provides the flexibility to support alternative procurement models as needed. It also provides the best path to giving the Government access to both the significant current supplier base of commercial VANs and the growing supplier base enabled by the Internet.

3. **Information resource databases.** The architectural framework should support ready access to information resource databases in standard formats interpretable by both humans and computers. By making it possible -- and desirable -- for participants to maintain data themselves, the government can get much higher quality critical information without the costs and responsibility of maintaining the data itself. (Examples range from on-line parts catalogs to vendor linecards to windows of opportunity for lifetime buys.)

4. **Sets of standards, rather than single standards.** The framework must accept multiple, industry-specific EDI transaction sets, and handle participants with incomplete implementations of any particular set. The government should therefore develop a standard database format for internal representation of EDI transactions, to facilitate translation between its formats and those supported by its trading partners. This reduces dependence on industry's schedules, and avoids the pitfalls of imposed solutions.

5. **Translation services.** The architectural framework should allow for translation services that convert between EDI formats, as well as between EDI and non-EDI formats. This gives maximum outreach to the widest supplier base, and frees the government from dependence on the pace at which the marketplace converges on particular formats.

Conclusions and Recommendations

Led by the commercial sector, Electronic Commerce is growing explosively on the Internet. Before the end of this decade, millions of individuals and companies will be buying, selling, bidding, brokering and collaborating on a daily basis, as the Internet merges with other branches of the information superhighway. The resulting economies of scale will drastically lower the cost of implementing and maintaining a procurement infrastructure. No VAN or government agency will be able to ignore the impact of making e-commerce services widely available at reasonable rates.

Today's Internet admittedly has limitations that make it unsuitable for mission critical applications. However the technology is in hand to create an "industrial strength" Internet that complies with all of the requirements and safeguards mandated in procurement regulations. In particular, use of the Internet for procurement does not preclude management control over the procurement process, including control over what services can be accessed and by whom.

There is a graceful migration strategy for transforming current and planned VAN-based EDI transactions into spontaneous and open electronic markets. This strategy builds on the concept of Internet-VAN gateways pioneered at laboratories such as USC/ISI and LLNL, and on more recent Internet-based architectures for electronic commerce, such as MCC's EINet and Smart Valley's CommerceNet. It gives the Government access to both the significant current supplier base of commercial VANs and the growing supplier base enabled by the Internet.

In the absence of universal standards for EDI transactions, the government should develop a standard internal representation and services that translate between its formats and those

supported by its trading partners. This approach reduces dependence on industry schedules for adopting standards, and avoids the pitfalls of a government-imposed solution.

As long time proponents of electronic commerce on public networks, we urge the Government to leverage its restructuring of procurement activities by taking advantage of the rapid technical developments that are now occurring, and the competitive forces they are unleashing. These forces will impact not only the price and quality of products offered in the marketplace, but also the price and quality of the technical infrastructure supporting the marketplace. Moreover, by making it possible -- and desirable -- for vendors to maintain catalogs and linecard data themselves, the government can get much higher quality information without the costs and responsibilities of maintaining it. In sum, the government will get a more robust solution with wider dissemination of support costs.

To seize these opportunities, the government should adopt an electronic commerce framework that embodies the five key concepts summarized above. The government should also encourage pilot efforts involving procurement on the Internet, to help shape the framework's evolution and to stimulate the development of innovative procurement services.